WHAT IS CLAIMED IS:

1. A rotor in a synchronous machine, comprising:

a superconducting field winding assembly having a coil winding and at least one winding support extending between opposite sides of the winding, and

a rotor core formed of a plurality of rotor core sections, each of said core sections having a slot to receive said winding support.

2. In a rotor as in claim 1 wherein said plurality of rotor core sections are axially aligned with an axis of said rotor core.

3. In a rotor as in claim 1 wherein said rotor core sections include opposite end core sections and at least one middle core section.

4. In a rotor as in claim 3 wherein said end core sections have a generally L-shaped cross section, and said at least one middle core section has a generally T-shaped cross section.

5. In a rotor as in claim 3 wherein at least one middle core section has a cross-sectional shape with a narrow head, where the head fits between a pair of bars of said winding supports.

6. In a rotor as in claim 5 wherein the at least one rotor core section has a wide region separated from the narrow head by a slot for the winding support.

7. In a rotor as in claim 1 further comprising at least one tie rod extending through said plurality of

rotor core sections and securing said core sections together.

8. In a rotor as in claim 1 further comprising a vacuum housing over said field coil winding.

9. In a rotor as in claim 1 wherein said core sections are iron.

10. In a rotor as in claim 1 wherein said core sections are iron forgings.

11. A rotor core and winding assembly comprising:

separable rotor core sections assembled around the winding assembly to form said rotor core, where said core sections are axially aligned in said rotor core, and

said winding assembly including a pre-assembled superconducting field winding and a winding support, wherein the winding support extends through said rotor core.

12. In a rotor as in claim 11 wherein said rotor core sections include opposite end core sections and at least one middle core section.

13. In a rotor as in claim 12 wherein said end core sections have a generally L-shaped cross section, and said at least one middle core section has a generally T-shaped cross section.

14. In a rotor as in claim 12 wherein at least one middle core section has a cross-sectional shape with a narrow head, where the head fits between a pair of said winding support bars.

15. In a rotor as in claim 14 wherein the at least one rotor core section has a wide region on an opposite side of the core section to the narrow head, and a winding slot between the wide region and narrow head.

16. In a rotor as in claim 11 further comprising at least one tie rod extending through said plurality of rotor core sections and securing said core sections together as said rotor core.

17. In a rotor as in claim 11 wherein said core sections are iron.

18. In a rotor as in claim 11 wherein said core sections are iron forgings.

19. In a rotor as in claim 11 wherein said winding has a race-track shape.

20. A method for assembling a rotor core around a superconducting field coil winding assembly comprising the steps of:

a. fabricating said field coil winding assembly by assembling a field coil winding and a coil support prior to assembly of the rotor core,

b. inserting a portion of each of a plurality of rotor core sections partially through said coil winding,

c. assembling the plurality of rotor core sections around said coil support, and

d. securing the assembly of rotor core sections.

21. A method for assembling a rotor core as in claim 20 wherein the insertion of a portion of each of a

plurality of rotor core sections includes inserting a narrow head of one of said rotor core sections between adjacent bars of the coil support.

22. A method for assembling a rotor core as in claim 20 wherein at least one of said plurality of rotor core sections includes a slot for to receive a tension bar of the coil support, and the slot is aligned with the tension bar when the at least one of said plurality of core sections is inserted through the coil winding to align the slot with the bar.